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Lee et al.

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(54) **MOBILE TERMINAL AND METHOD OF CONTROLLING THE SAME**

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(51) **Int. Cl.**

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H04N 5/262	(2006.01)
G06K 9/40	(2006.01)
G03B 35/00	(2006.01)

(52) **U.S. Cl.**

USPC **348/333.04**; 348/46; 348/208.1; 348/222.1; 348/239; 348/333.02; 382/254; 382/255; 396/324; 396/325

(58) **Field of Classification Search**

USPC 348/42–60, 208.99–208.16, 222.1, 239, 348/241, 333.01–333.13; 382/254–275; 396/322–340

See application file for complete search history.

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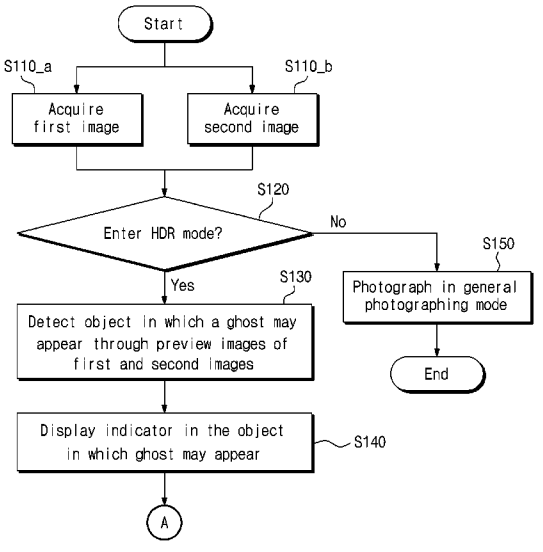
(57) **ABSTRACT**

A mobile terminal and a method of controlling the same are provided. The mobile terminal detects an object in which a ghost may appear through a preview image of an image acquired using a dual camera. The mobile terminal may display an indicator for identifying the detected object. Accordingly, a higher quality high dynamic range (HDR) image can be more efficiently acquired.

20 Claims, 16 Drawing Sheets



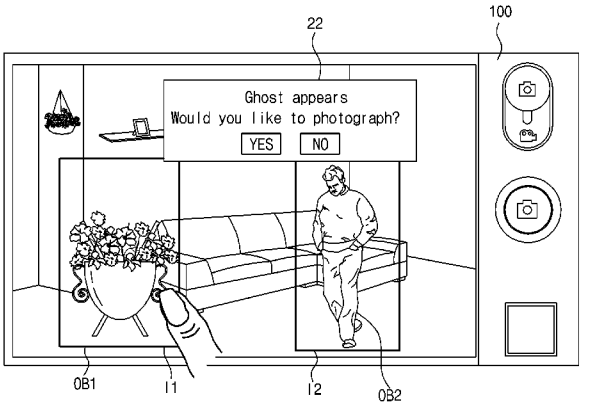


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FIG. 1

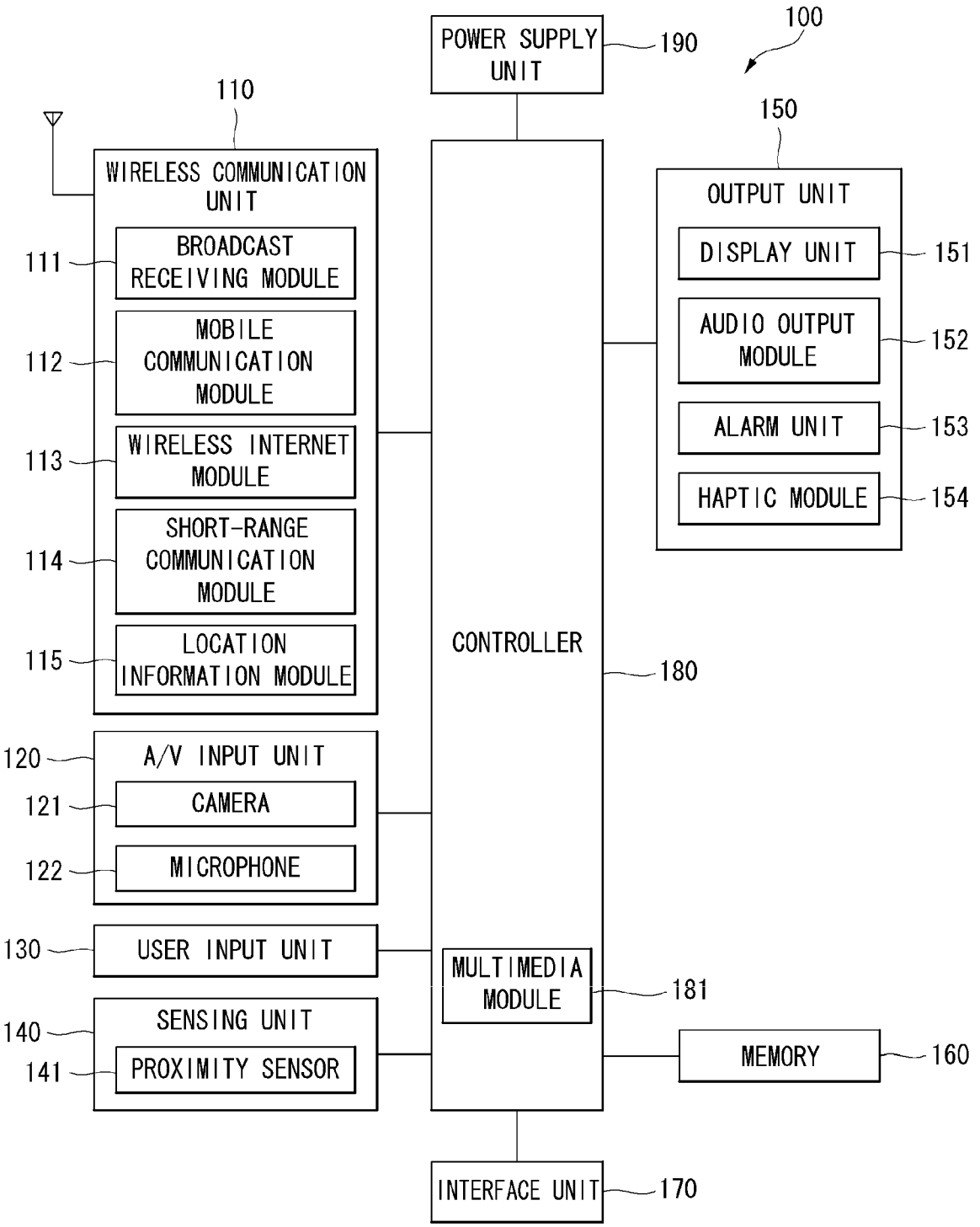

100
POWER SUPPLY UNIT
190
110
WIRELESS COMMUNICATION UNIT
111
BROADCAST RECEIVING MODULE
112
MOBILE COMMUNICATION MODULE
113
WIRELESS INTERNET MODULE
114
SHORT-RANGE COMMUNICATION MODULE
115
LOCATION INFORMATION MODULE
120
A/V INPUT UNIT
121
CAMERA
122
MICROPHONE
130
USER INPUT UNIT
140
SENSING UNIT
141
PROXIMITY SENSOR
CONTROLLER
180
MULTIMEDIA MODULE
181
INTERFACE UNIT
170
150
OUTPUT UNIT
DISPLAY UNIT
151
AUDIO OUTPUT MODULE
152
ALARM UNIT
153
HAPTIC MODULE
154
MEMORY
160

FIG. 2A

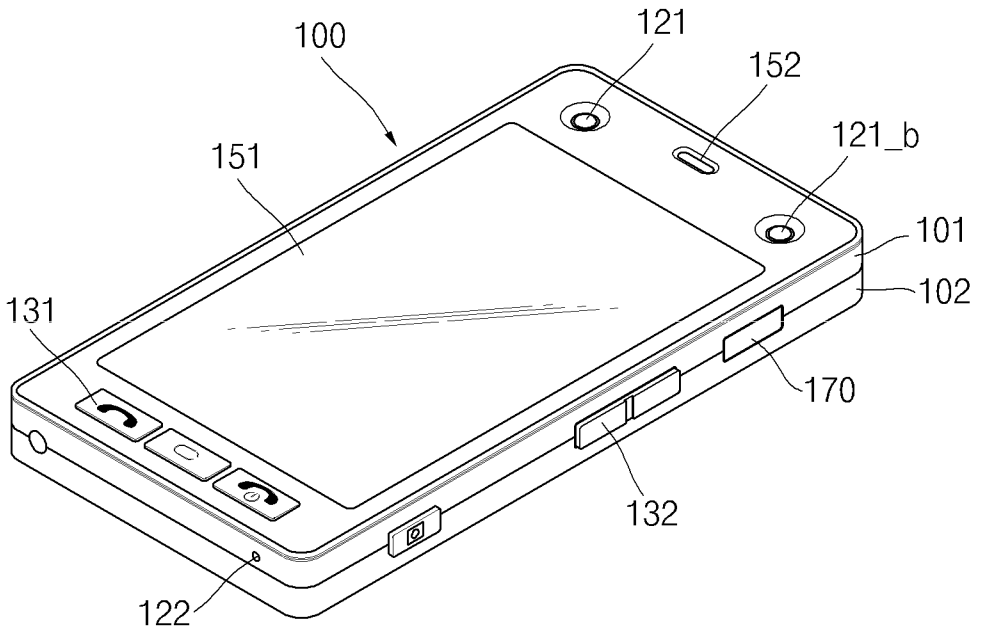

100
121
152
121_b
151
101
102
131
170
132
122

FIG. 2B

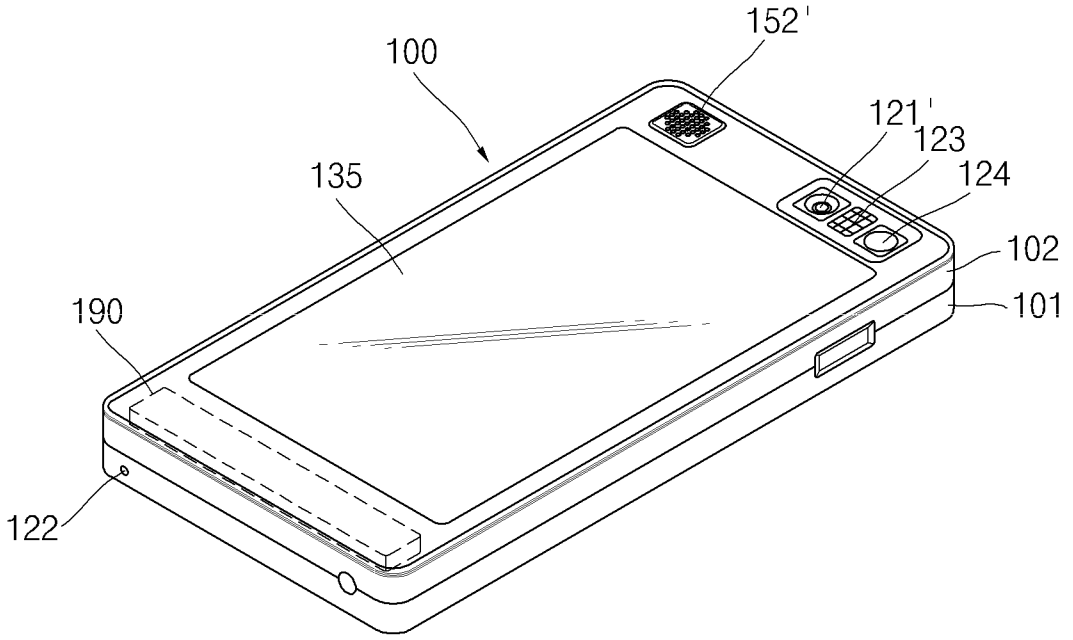

152'
100
121'
123
135
124
102
190
101
122

FIG. 3

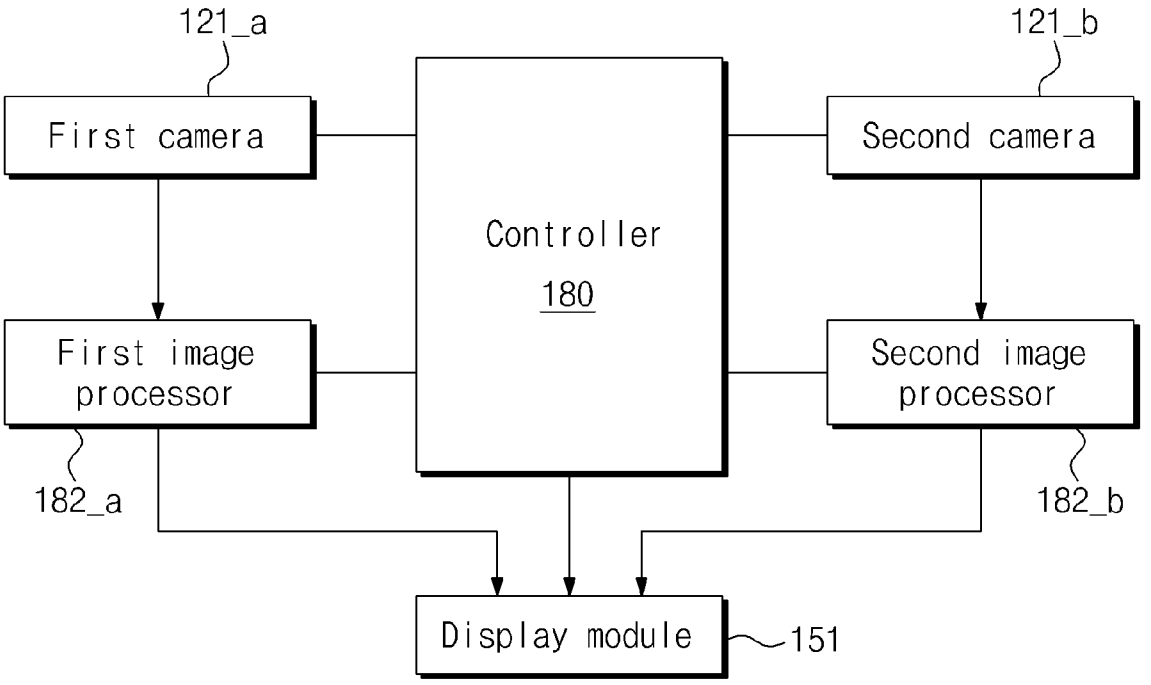

121_a
121_b
First camera
Second camera
Controller
180
First image processor
Second image processor
182_a
182_b
Display module
151

FIG. 4

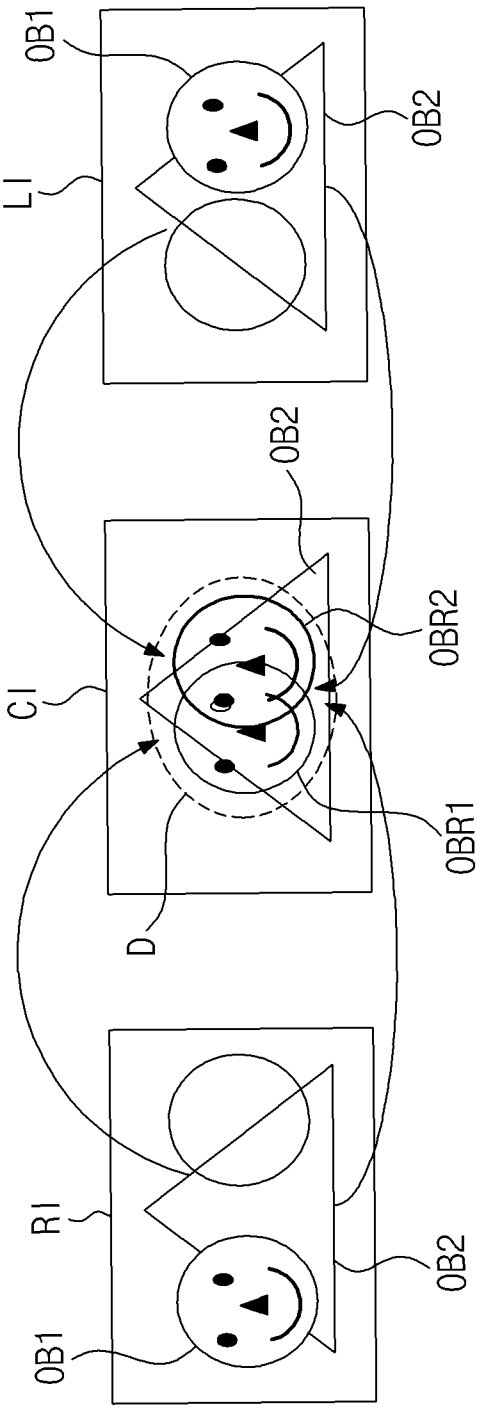


FIG. 5

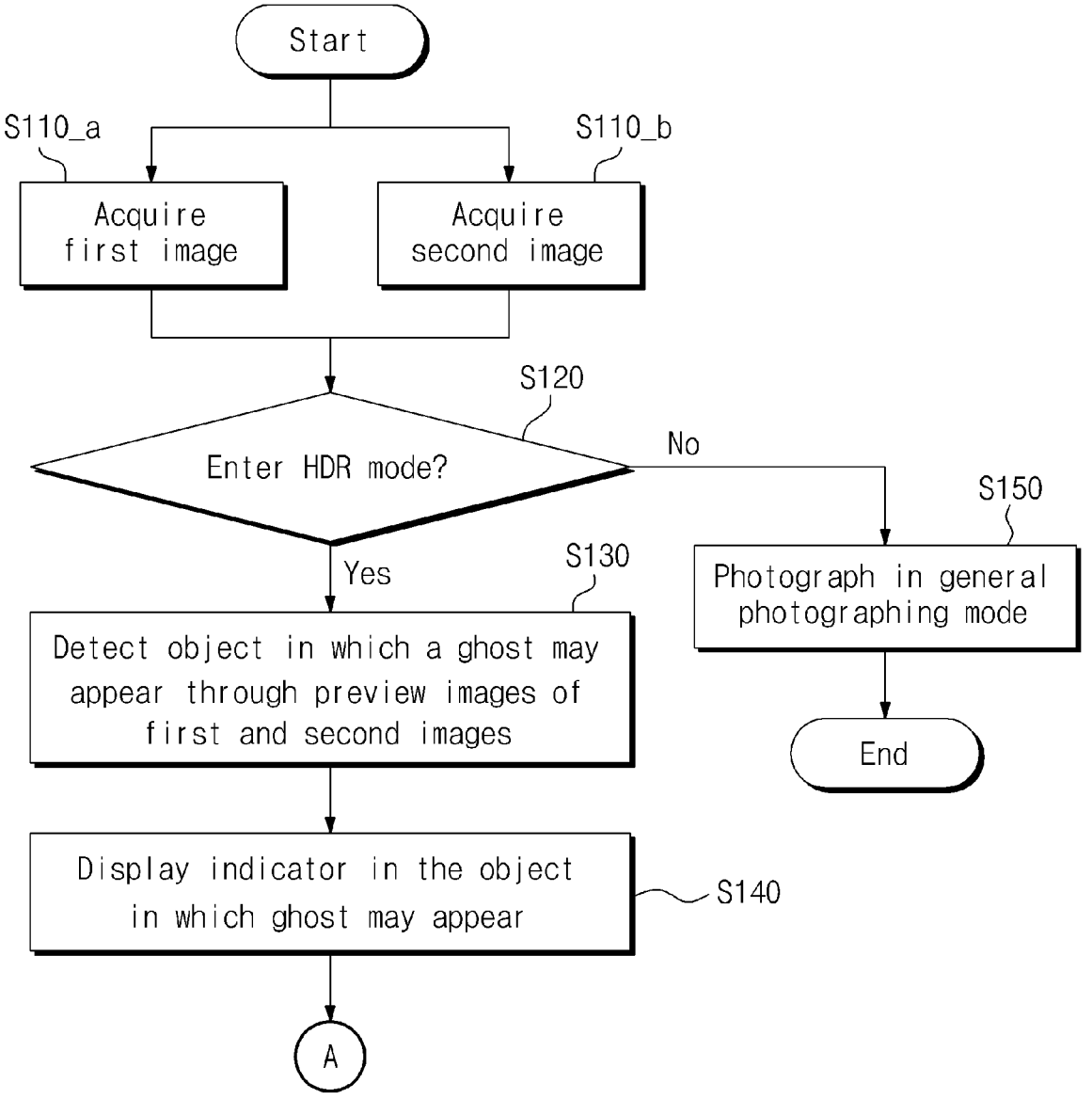

Start
S110_a
S110_b
Acquire first image
Acquire second image
S120
Enter HDR mode?
No
S150
Yes
S130
Photograph in general photographing mode
Detect object in which a ghost may appear through preview images of first and second images
End
Display indicator in the object in which ghost may appear
S140
A

FIG. 6

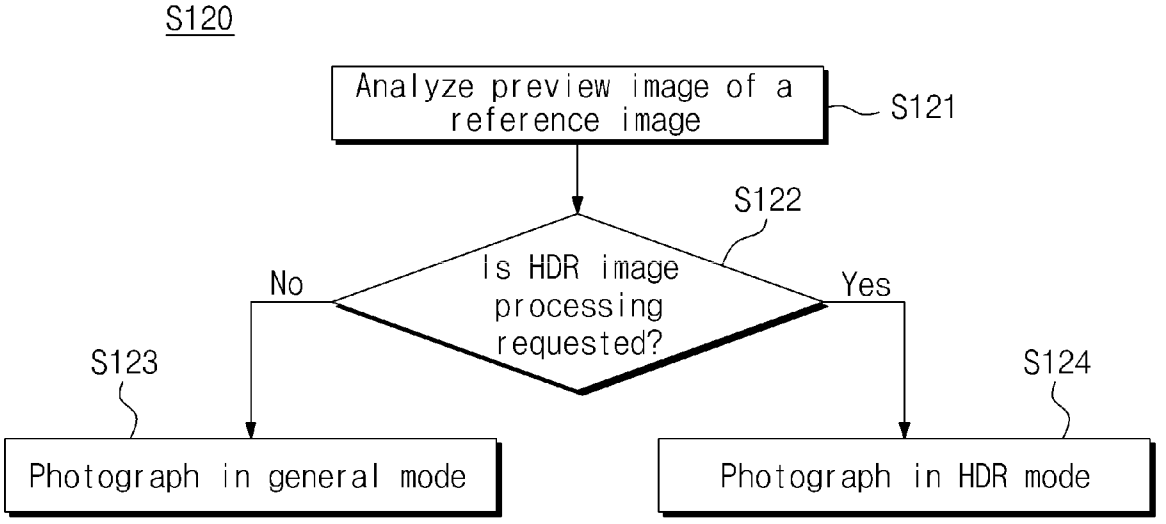

S120
Analyze preview image of a reference image
S121
S122
Is HDR image processing requested?
No
Yes
S123
S124
Photograph in general mode
Photograph in HDR mode

FIG. 7

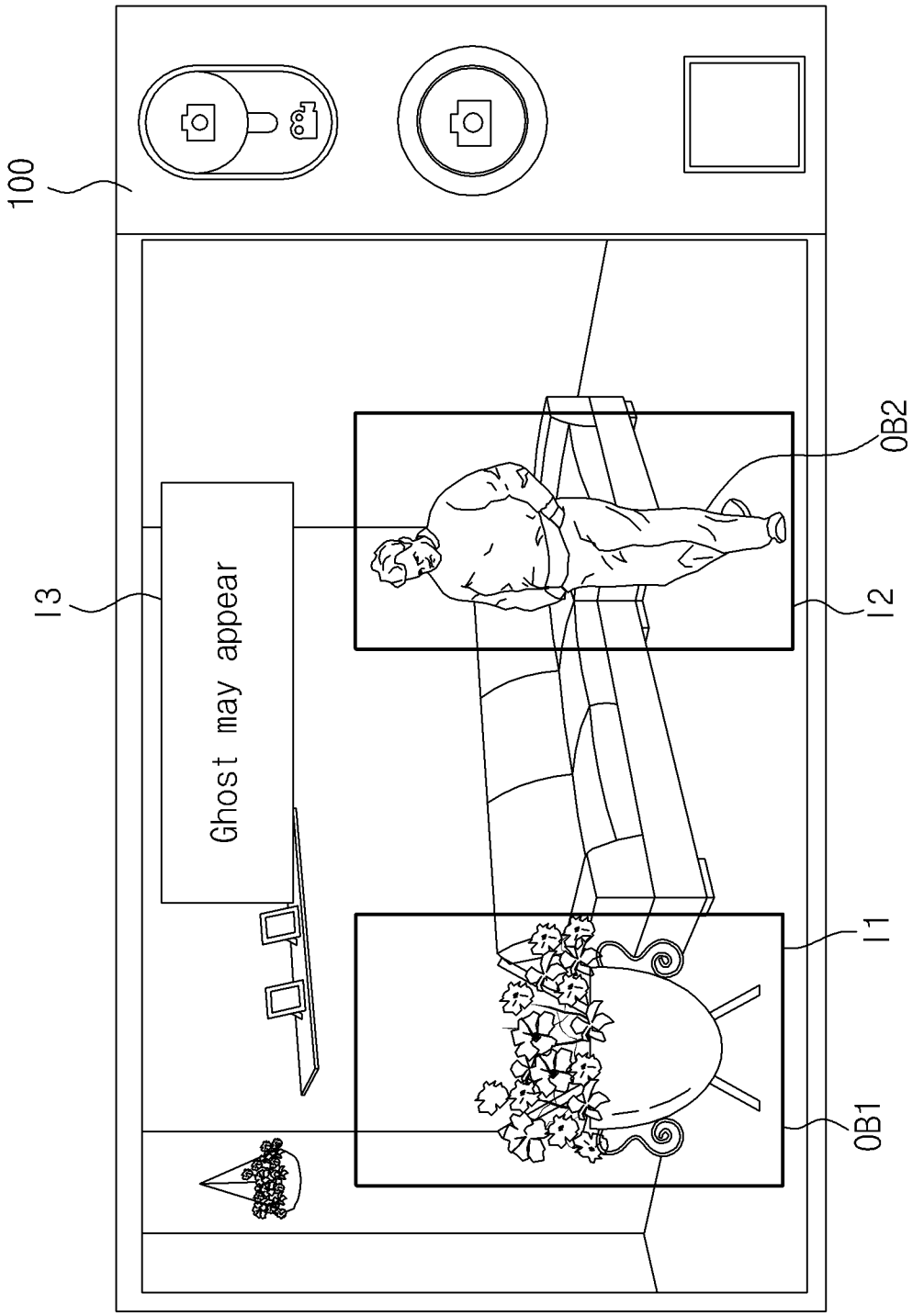


FIG. 8

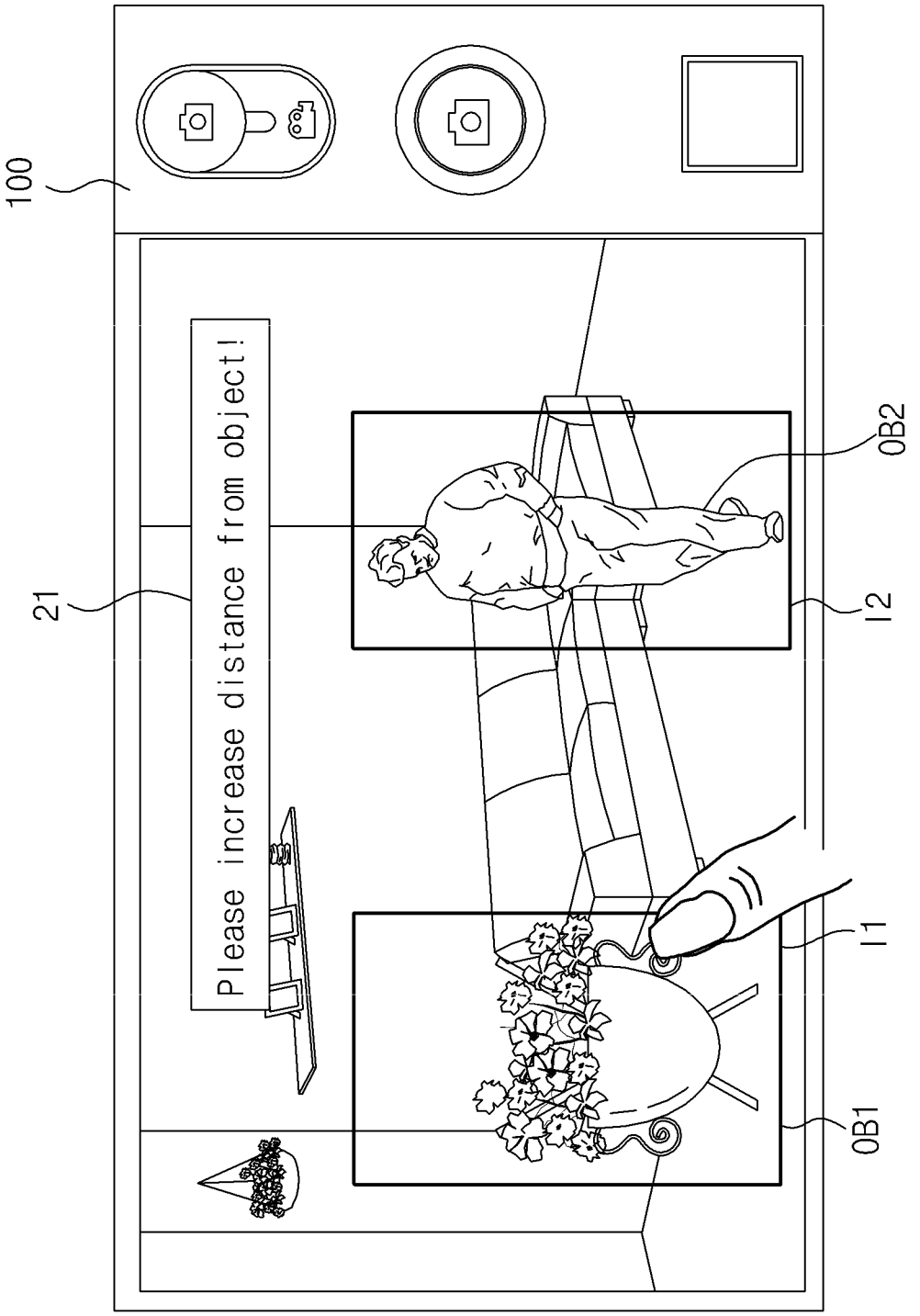


FIG. 9

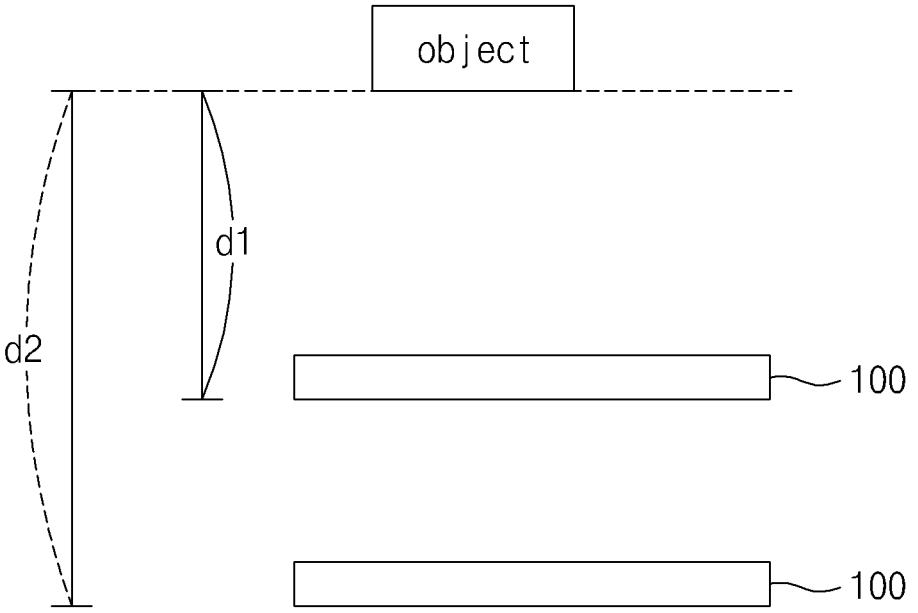
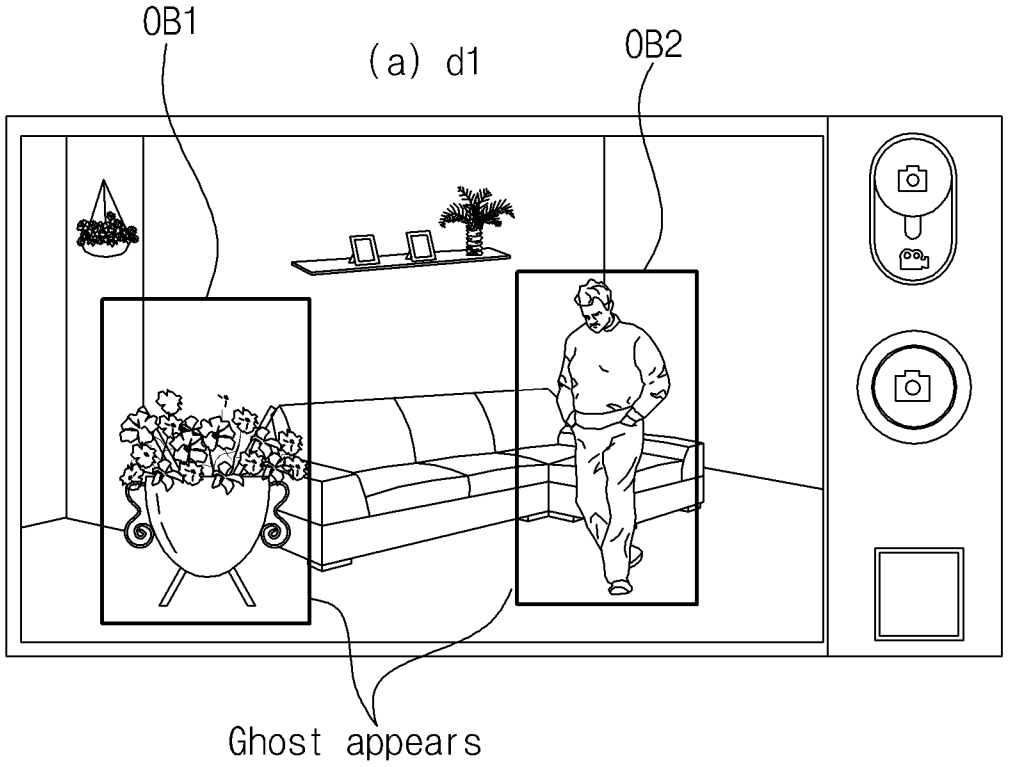


FIG. 10



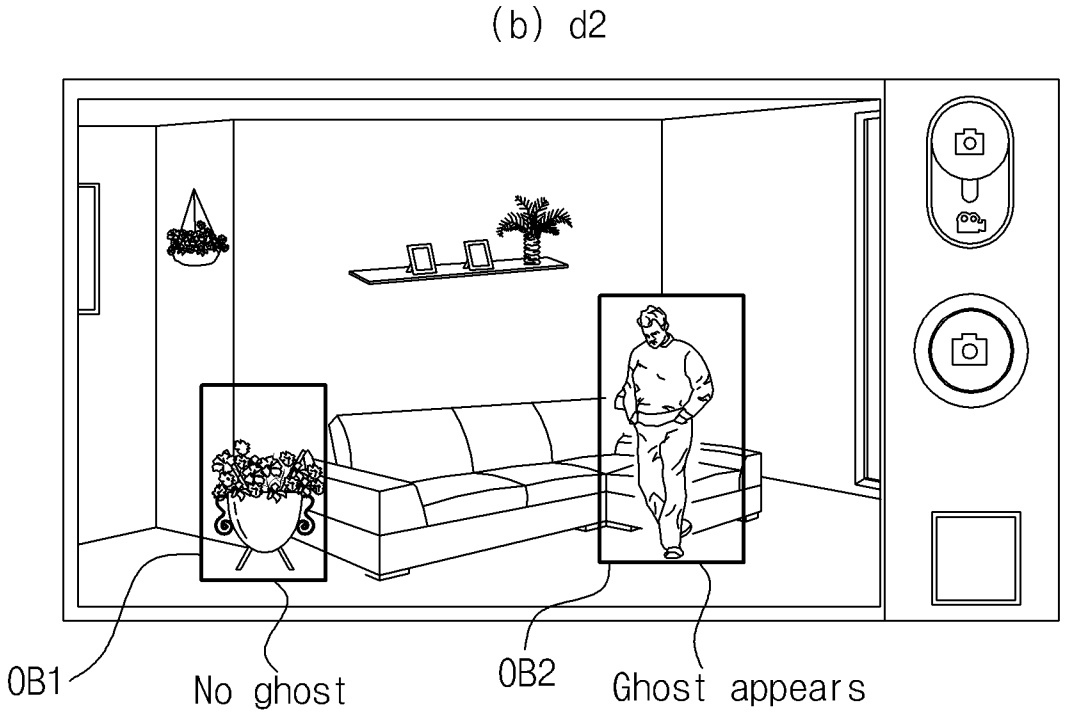


FIG. 11

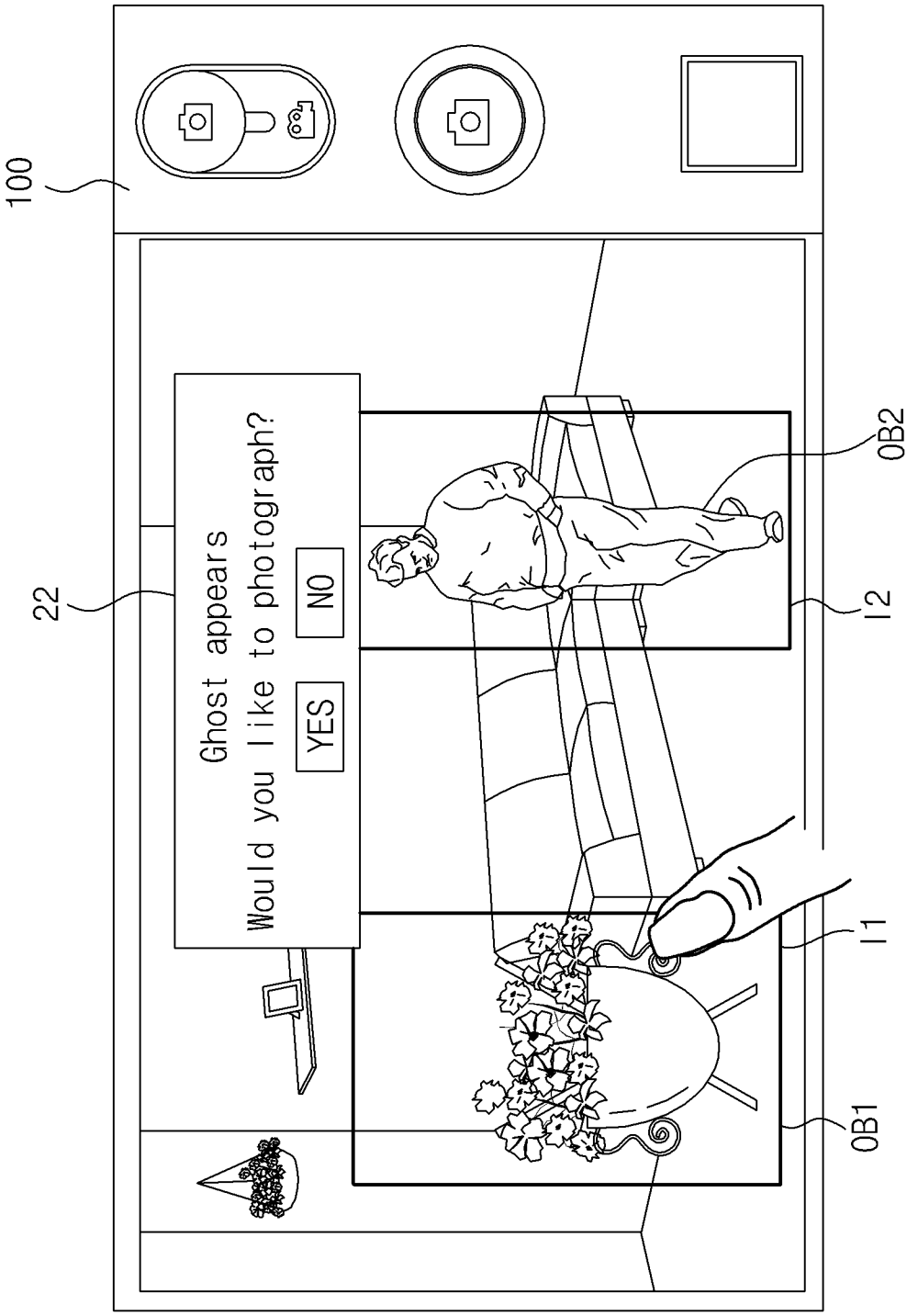

100
22
Ghost appears
Would you like to photograph?
YES
NO
I2
I1
OB2
OB1

FIG. 12

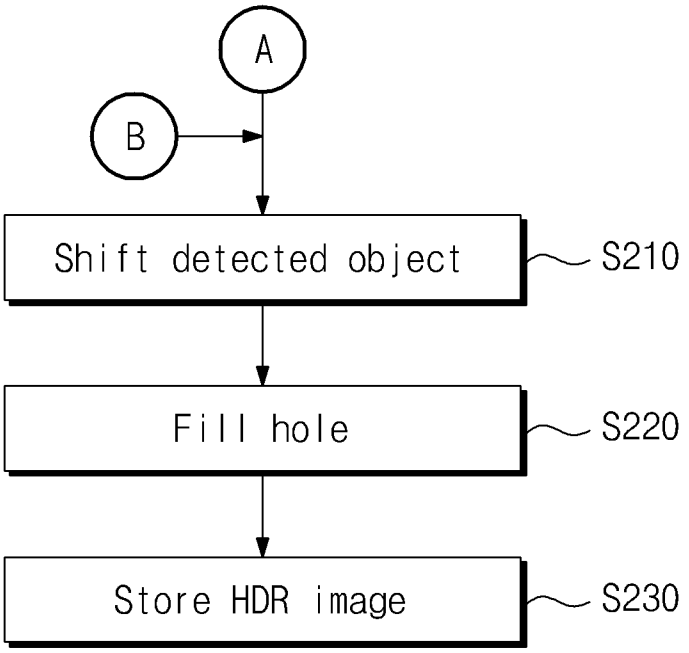

A
B
Shift detected object
S210
Fill hole
S220
Store HDR image
S230

FIG. 13

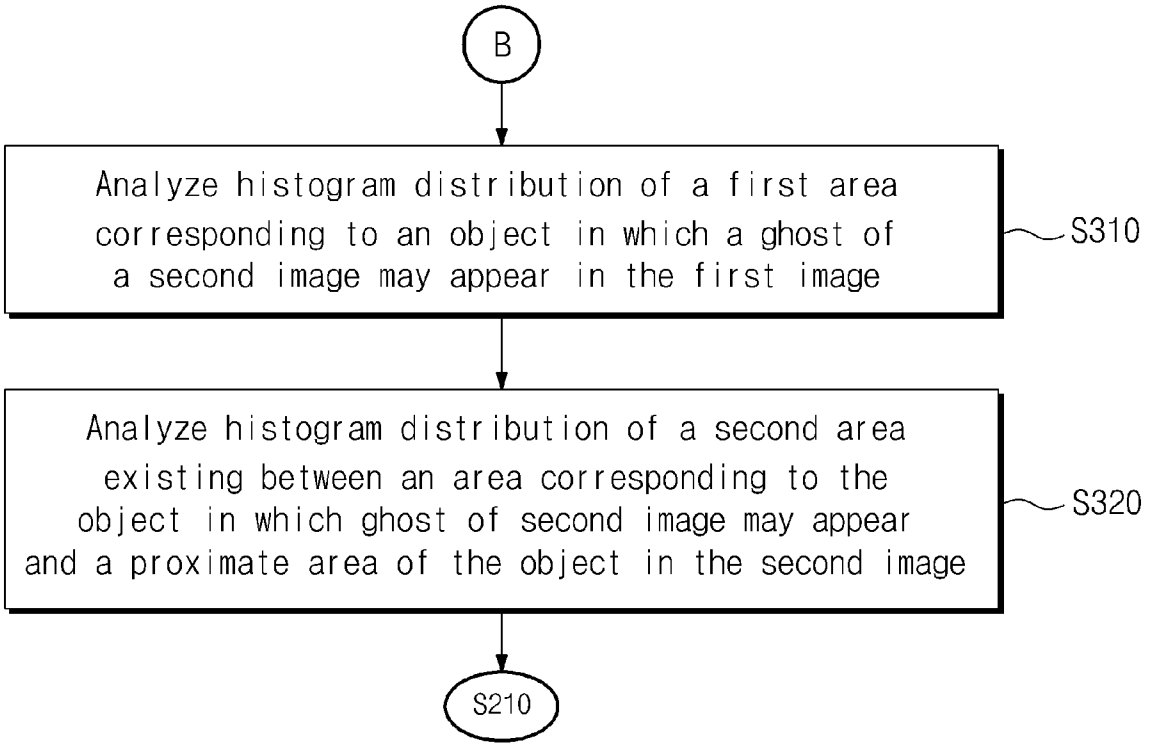

B
Analyze histogram distribution of a first area corresponding to an object in which a ghost of a second image may appear in the first image
S310
Analyze histogram distribution of a second area existing between an area corresponding to the object in which ghost of second image may appear and a proximate area of the object in the second image
S320
S210

FIG. 14

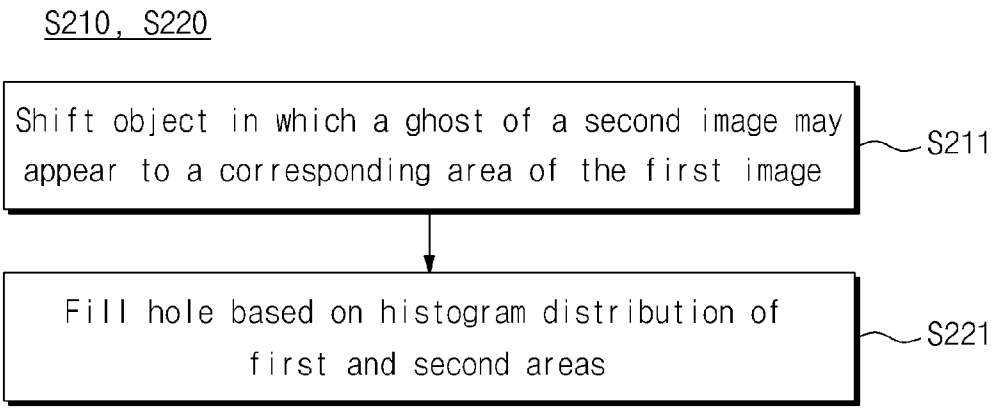

S210, S220
Shift object in which a ghost of a second image may appear to a corresponding area of the first image
S211
Fill hole based on histogram distribution of first and second areas
S221

FIG. 15

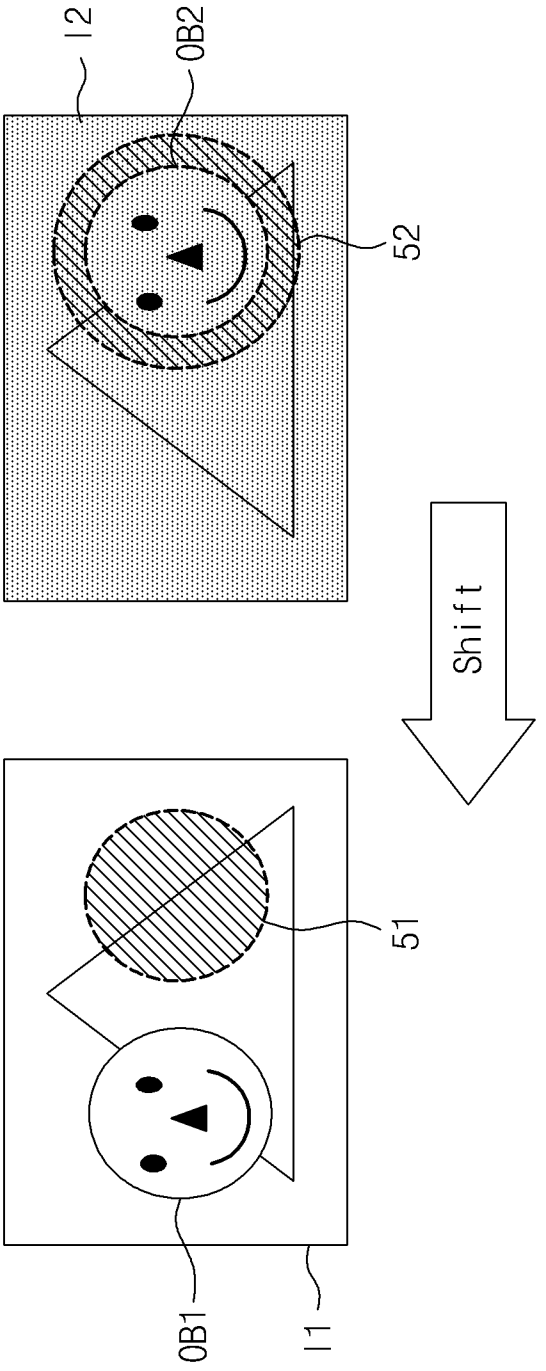


FIG. 16

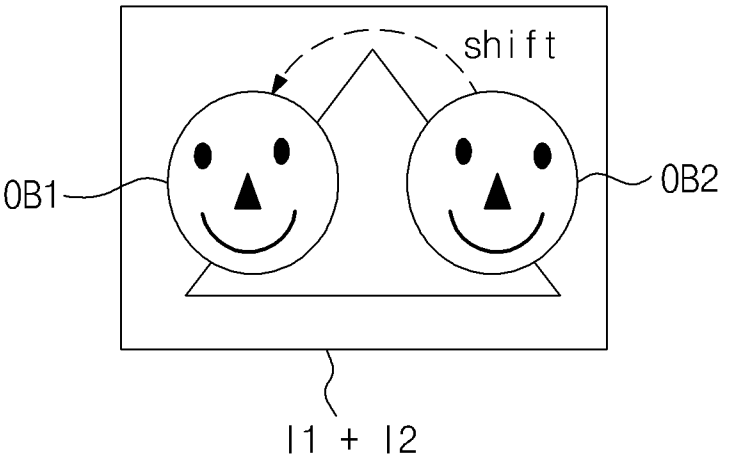
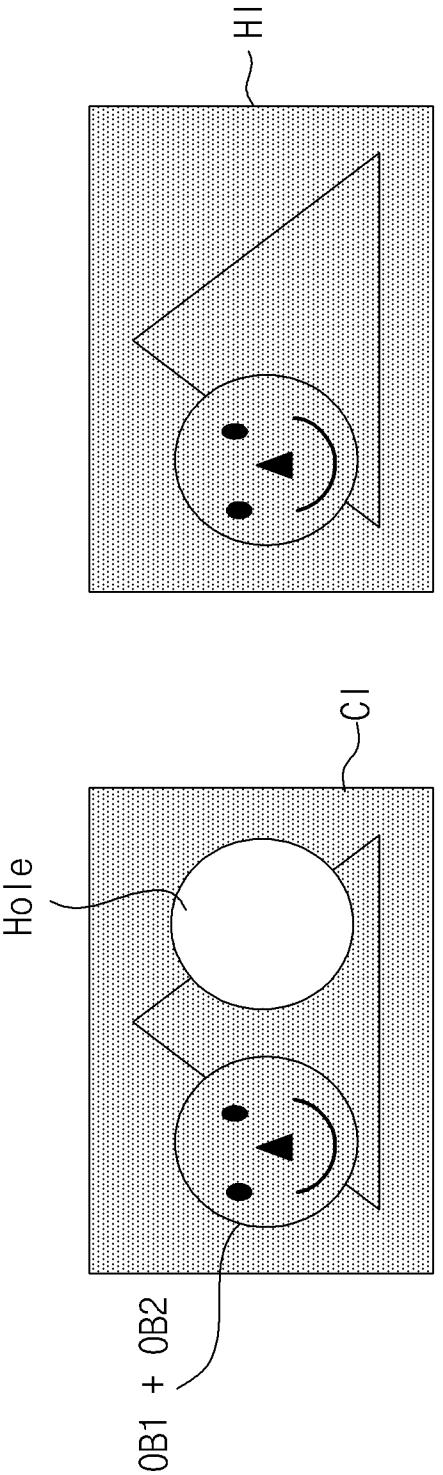


FIG. 17



MOBILE TERMINAL AND METHOD OF CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

Pursuant to 35 U.S.C. §119(a), this application claims the benefit of earlier filing date and right of priority to Korean Patent Application No. 10-2011-0083757, filed on Aug. 23, 2011, the contents of which are hereby incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention relates to a mobile terminal and a method of controlling the same.

RELATED ART

High dynamic range imaging (HDRI) is a digital image processing technique that can process a dynamic range (DR). HDRI was first developed to improve a quality of an image rendered by a computer. Thereafter, a method was developed to obtain a picture with a high DR from several pictures photographed in different exposure states.

When a high dynamic range (HDR) image is acquired using a single camera capturing two images with different exposure states, the following problems may occur due to a time interval between the capturing of the two images. First, either image may be shifted due to the shaking hands of the camera operator. Secondly, a difference in a position and a shape of a moving object may cause a faint image, sometimes called a "ghost," to appear in a captured image.

Technology that acquires and processes an HDR image in a mobile terminal environment can overcome these problems, as well as possess many other benefits, for mobile terminals and other image capturing devices.

SUMMARY

Among other things, the claimed invention provides a mobile terminal and a method of acquiring and processing an HDR image.

A mobile terminal can include: a display unit; a first camera configured to acquire a first image from a first view point; a second camera configured to acquire a second image from a second view point that is different from the first view point; and a controller configured to: determine whether high dynamic range (HDR) image processing is requested based on preview images of the first and second images, detect at least one object comprising a ghost in the preview images of the first or second images, and control the display unit to display an indicator corresponding to the detected at least one object.

The controller may switch a photographing mode to an HDR operating mode when the preview image of the first image includes at least one saturation area.

The controller may determine that a ghost appears based on a preview image of the first image and a preview image of a second image when the preview images of the first and second images are overlapped and a disparity exists between the preview images of the first and second images.

An indicator may include at least a highlight, a text or a voice message of the detected at least one object. The detected at least one object may exist in at least the preview image of the first image or the preview image of the second image.

The controller may provide information about a disparity between the detected at least one objects based on a distance between the mobile terminal and a selected at least one object.

The controller may provide a user selection menu. The user selection menu can be configured to enable capture and display of at least a video or an image, wherein the at least video or image may contain the aforementioned disparity.

The controller may re-detect the at least one object in which a ghost appears and provide an indicator corresponding to the re-detected at least one object.

The first camera may be set to capture an over-exposed image, and the second camera may be set to capture an under-exposed image.

A method of controlling a mobile terminal can include: acquiring a first image via a first camera from a first view point; acquiring a second image via a second camera from a second view point that is different from the first view point; entering a high dynamic range (HDR) operating mode; detecting at least one object comprising a ghost in the preview images of the first or second images; and displaying an indicator corresponding to the detected at least one object.

A method of controlling a mobile terminal can also include: analyzing a histogram distribution of a first area corresponding to the detected at least one object comprising a ghost in the first image; analyzing the histogram distribution of a second area located between the at least one object comprising the ghost in the second image and the proximate area relative to the second area; overlapping the first and the second images; shifting the detected at least one object from the second image to a corresponding area of the first image; and changing the histogram distribution of the first area with reference to the histogram distribution of the second area.

An HDR image can be acquired utilizing the apparatus or method of the claimed invention. When an image is acquired using a dual camera employing the apparatus or method of the claimed invention, even if the hands of the camera operator shake, the captured image will not appear shifted. Also, when images are acquired using a dual camera utilizing the apparatus or method of the claimed invention, even if a moving object changes its position or shape, a ghost does not appear in the captured image.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show some embodiments of the claimed invention. The accompanying drawings are intended to be exemplary illustrations but are not intended to preclude alternative embodiments that are within the spirit and scope of the claimed invention.

FIG. **1** illustrates a block diagram of a mobile terminal according to an embodiment of the claimed invention.

FIG. **2**A illustrates a front perspective view of a mobile according to an embodiment of the claimed invention.

FIG. **2**B illustrates a rear perspective view of the mobile terminal illustrated in FIG. **2**A.

FIG. **3** illustrates a block diagram representing a method of controlling the mobile terminal illustrated in FIG. **1**.

FIG. **4** illustrates an example of a ghost appearing on images captured using a dual camera when the captured images are synthesized together.

FIG. **5** illustrates a flowchart representing a method of controlling a mobile terminal according to an alternative embodiment of the claimed invention.

FIG. **6** illustrates a flowchart representing a method of setting a mobile terminal to an HDR mode.

FIG. **7** illustrates a user interface providing notification that a ghost may appear on a preview image.

FIG. **8** illustrates a user interface providing notification to adjust a distance between the mobile terminal and a subject when a ghost may appear on a preview image.

FIG. **9** illustrates that HDR processing can be adjusted according to a distance between the mobile terminal and the subject.

FIG. **10** illustrates that a ghost may appear according to a distance between the mobile terminal and the subject.

FIG. **11** illustrates a user interface providing notification that a hole filling process can be performed on an image that may otherwise contain a ghost.

FIGS. **12** to **14** are flowcharts illustrating a method of performing the hole filling processing.

FIGS. **15** to **17** are illustrations corresponding to the method of performing hole filling processing as depicted in FIGS. **12** to **14**.

DETAILED DESCRIPTION

The claimed invention will now be described more fully with reference to the accompanying drawings. Embodiments of the claimed invention are not limited to the embodiments set forth herein. A mobile terminal relating to the claimed invention will be described below in more detail with reference to the accompanying drawing(s). In the following description, suffixes "module" and "unit" are given to components of the mobile terminal to facilitate description of the claimed invention.

The mobile terminal can include a cellular phone, a smart phone, a laptop computer, a digital broadcasting terminal, personal digital assistants (PDA), a portable multimedia player (PMP), a navigation system or other similar device.

FIG. **1** is a block diagram of a mobile terminal **100** according to an embodiment of the claimed invention. The mobile terminal can include at least a wireless communication unit **110**, an A/V (Audio/Video) input unit **120**, a user input unit **130**, a sensing unit **140**, an output unit **150**, a memory **160**, an interface unit **170**, a controller **180** and a power supply unit **190**. FIG. **1** shows the mobile terminal as having various components, but use of all these illustrated components is not required.

The wireless communication unit **110** can include one or more components allowing radio communication between the mobile terminal **100** and a wireless communication system or a network where the mobile terminal is located. For example, in FIG. **1**, the wireless communication unit includes at least a broadcast receiving module **111**, a mobile communication module **112**, a wireless Internet module **113**, a short-range communication module **114**, or a location information module **115**.

The broadcast receiving module **111** receives at least broadcast signals or broadcast associated information from an external broadcast management server via a broadcast channel. Further, the broadcast channel may include at least a satellite channel or a terrestrial channel. The broadcast management server may be (1) a server that generates and transmits at least a broadcast signal or broadcast associated information or (2) a server that receives at least a previously generated broadcast signal or broadcast associated information and transmits the same to a terminal. The broadcast signal can include a TV broadcast signal, a radio broadcast signal, a data broadcast signal or any other similar signal. Also, the broadcast signal can further include a broadcast signal combined with a TV or radio broadcast signal.

The broadcast associated information may refer to information associated with at least a broadcast channel, a broadcast program or a broadcast service provider. The broadcast associated information may be provided via a mobile communication network, and the broadcast associated information may be received by the mobile communication module **112**.

The broadcast signal may exist in various forms; for example, the broadcast signal can exist in a form of an electronic program guide (EPG) of the digital multimedia broadcasting (DMB) system, an electronic service guide (ESG) of the digital video broadcast-handheld (DVB-H) system, or other similar forms.

The broadcast receiving module **111** may also be configured to receive signals broadcast using various types of broadcast systems. For example, the digital broadcast system can be a multimedia broadcasting-terrestrial (DMB-T) system, a digital multimedia broadcasting-satellite (DMB-S) system, a digital video broadcast-handheld (DVB-H) system, a data broadcasting system known as the media forward link only (MediaFLO®), an integrated services digital broadcast-terrestrial (ISDB-T) system, or other similar system.

The broadcast receiving module **111** can also be configured to be compatible with all other broadcast systems that provide a broadcast signal. The broadcast signals or broadcast-associated information received via the broadcast receiving module may be stored in the memory **160**.

The mobile communication module **112** can at least transmit radio signals to or receive radio signals from at least a base station, an external terminal or a server. Such radio signals can include at least a voice call signal, a video call signal, various types of data signals, or a multimedia message.

The wireless Internet module **113** supports wireless Internet access for the mobile terminal and can be internally or externally coupled to the mobile terminal. The wireless Internet access technique implemented can include a Wireless LAN (WLAN) Wireless Fidelity (Wi-Fi), Wireless broadband (Wibro), World Interoperability for Microwave Access (Wimax), High Speed Downlink Packet Access (HSDPA), or other the similar system.

The short-range communication module **114** is a module for supporting short range communications. Some examples of short-range communication technology include Bluetooth™, Radio Frequency IDentification (RFID), Infrared Data Association (IrDA), Ultra-WideBand (UWB), ZigBee™, or other similar short-range communication technology.

The location information module **115** is a module for checking or acquiring a location or position of the mobile terminal. The location information module may acquire location information by using a Global Navigation Satellite System (GNSS). GNSS is a standard generic term for satellite navigation systems revolving around the Earth and allowing certain types of radio navigation receivers to transmit reference signals that determine their location on or in the vicinity of the surface of the Earth. GNSS may include the United States' Global Positioning System (GPS), the European Union's Galileo positioning system, the Russian Global Orbiting Navigational Satellite System (GLONASS), a Compass Navigation System (COMPASS) by the People's Republic of China, and the Quasi-Zenith Satellite System (QZSS) by Japan.

A GPS module may calculate information related to the distance between a point (or entity) to three or more satellites as well as information related to the time at which the distance information was measured. The GPS module can then apply trigonometric principles to the calculated distance to calculate three-dimensional location information including latitude, longitude, and altitude with respect to the point (or entity). Alternatively, a method of acquiring location and time

information by using three satellites and correcting for any error of the calculated location and time information may be used. The GPS module can continuously calculate current location information of the point (or entity) in real time as well as calculate speed information using the continuously calculated current location information.

With reference to FIG. **1**, the A/V input unit **120** is configured to receive at least an audio or a video signal. The NV unit can include at least a camera **121** or a microphone **122**. The camera **121** can process image data of at least still pictures or video data obtained by an image capture device in a video capturing mode or an image capturing mode. The A/V unit can also process image frames that can be displayed on a display unit **151**.

Image frames processed by the camera **121** can be stored in the memory **160** or transmitted elsewhere via the wireless communication unit **110**. The mobile terminal **100** can comprise two or more cameras **121**.

The microphone **122** can receive sounds while in at least a phone call mode, a recording mode, a voice recognition mode, or a similar mode. The microphone can also process such sounds into audio data. The processed audio data may then be converted for output as a format transmittable to a mobile communication base station. Transmission of the converted output can occur via the mobile communication module **112** during the phone call mode. The microphone can also implement various types of noise canceling (or suppression) algorithms to cancel or suppress noise or other auditory interference when receiving or transmitting the audio signals.

The user input unit **130** can generate input data from commands entered by a user to control various operations of the mobile terminal **100**. The user input unit can include at least a keypad, a dome switch, a touch pad (e.g., a touch-sensitive member that detects changes in resistance, pressure, or capacitance resulting from a contact), a jog wheel, a jog switch, or other similar component.

The sensing unit **140** detects a current status of the mobile terminal **100**, such as an opened or closed state of the mobile terminal, a location of the mobile terminal, a presence or absence of user contact with the mobile terminal, the orientation of the mobile terminal, an acceleration or deceleration of movement or direction of movement of the mobile terminal, and other similar information about the mobile terminal.

The sensing unit **140** can also generate commands or signals for controlling the operation of the mobile terminal **100**. For example, when the mobile terminal is implemented as a slide-type phone, the sensing unit may sense whether the slide-type component has been slid open or slid closed. The sensing unit can also detect whether or not the power supply unit **190** supplies power. The sensing unit can also detect whether the interface unit **170** is coupled to an external device. In FIG. **1**, the sensing unit is illustrated as including a proximity sensor **141**.

The output unit **150** is configured to provide outputs in at least a visual, audible or tactile manner. In FIG. **1**, the output unit can include the display unit **151**, an audio output module **152**, an alarm unit **153**, a haptic module **154**, and other related modules. The display unit **151** can display information processed in the mobile terminal **100**. For example, when the mobile terminal is set to a phone call mode, the display unit can display a User Interface (UI) or a Graphic User Interface (GUI) associated with a call.

The display unit **151** can also include at least a Liquid Crystal Display (LCD), a Thin Film Transistor-LCD (TFT-LCD) display, an Organic Light Emitting Diode (OLED) display, a flexible display, a three-dimensional (3D) display, or other similar display. Some displays can also be configured as transparent or light-transmissive. An example transparent display is a TOLED (Transparent Organic Light Emitting Diode) display. A rear structure of the display unit may be also light-transmissive. As a result, the user can view an object positioned at a rear side of the terminal body through a region occupied by the display unit of the terminal body.

In some embodiments of the claimed invention, the mobile terminal **100** can include two or more display units **151**. For example, a plurality of display units can be separately or integrally disposed on one surface of the mobile terminal. Alternatively, the plurality of display units can be separately disposed on mutually different surfaces.

When the display unit **151** and a sensor (also referred to as a 'touch sensor') for detecting a touch operation are overlaid in each other, the display unit can function as both an input device and an output device. The touch sensor can have at least a form of a touch film, a touch sheet, a touch pad or other touch component.

The touch sensor can be configured to convert pressure applied to a particular portion of the display unit **151**, a change in the capacitance, or other change generated at a particular portion of the display unit into an electrical input signal. The touch sensor can also be configured to detect the pressure, position and area of a touch.

When there is a touch input with respect to the touch sensor, corresponding signals are transmitted to a touch controller, and the touch controller processes the signals and transmits corresponding data to the controller **180**. Accordingly, the controller can recognize which portion of the display unit **151** has been touched.

With reference to FIG. **1**, the proximity sensor **141** may be located within or near the touch screen. The proximity sensor can be a sensor for detecting the presence or absence of an object relative to a certain detection surface. The proximity sensor can also be a sensor for detecting an object that exists nearby using electromagnetism forces or infrared rays. The proximity sensor has a considerably longer life span as compared to a contact-type sensor.

Examples of the proximity sensor **141** can include a transmission type photoelectric sensor, a direct reflection type photoelectric sensor, a mirror-reflection type photo sensor, an RF oscillation type proximity sensor, a capacitance type proximity sensor, a magnetic proximity sensor, an infrared proximity sensor, or other similar sensor. When the touch screen is set to detect changes to capacitance, a proximity of the pointer is detected by a change in an electric field according to the proximity of the pointer relative to the touch screen. Such a sensor may be called a proximity sensor.

In the following description, recognition of a pointer positioned close to the touch screen will be called a 'proximity touch,' while recognition of actual contacting of the pointer to the touch screen will be called a 'contact touch.' Further, when the sensor is set to detect a proximity touch, the pointer is positioned to correspond vertically to the touch screen.

By using the proximity sensor **141**, a proximity touch and a proximity touch pattern (e.g., a proximity touch distance, a proximity touch speed, a proximity touch time, a proximity touch position, a proximity touch movement state, or other similar state) can be detected. Information corresponding to a proximity touch operation and the proximity touch pattern can be displayed on the display unit **151**.

The audio output module **152** can convert audio signals into audio data and, subsequently, output the audio data via the wireless communication unit or store the audio data in the memory **160**. The audio output module can perform these functions while the mobile terminal **100** is in a call signal reception mode, a call mode, a record mode, a voice recog-

nition mode, a broadcast reception mode, or other similar mode. The audio output module can provide audible outputs (e.g., a call signal reception sound, a message reception sound, or other similar sound) related to a particular function performed by the mobile terminal. The audio output module can also include a speaker, a buzzer or other similar component. Also, the audio output module can output sounds through an earphone jack.

The alarm unit **153** can output information about the occurrence of an event related to the mobile terminal **100**. Typical events can include call reception, message reception, key signal inputs, a touch input, or any other event associated with the mobile terminal. The audio signal may also be output through the display unit **151** or the audio output module **152**. The alarm unit can also provide an output in the form of a vibration or a video signal.

The haptic module **154** generates various tactile effects the user may feel. One example of the tactile effects generated by the haptic module **154** is vibration. The strength and pattern of the haptic module **154** can also be controlled. For example, different vibrations can be combined, intermittent or sequential.

The haptic module **154** can also generate various other tactile effects. One example is a stimulation from a pin arrangement vertically moving with respect to a contact skin. Another example is an air spray force through a jet orifice or air suction force through a suction opening. Other examples include a contact on a skin, a contact of an electrode on the skin, an electrostatic force on the skin, stimulating a sense of cold or warmth, and other similar forms of tactile stimulation.

The haptic module **154** may also allow a user to feel a tactile effect through a sensation onto a part of a finger, hand or arm of the user. The haptic module may also transfer the tactile effect through a direct contact. In an alternative embodiment, two or more haptic modules may be provided in the mobile terminal **100**.

The memory **160** can store software programs used for the processing and controlling operations performed by the controller **180**. Alternatively, the memory can temporarily store data (e.g., a phonebook, messages, still images, a video, or other similar data) that are input in or output from the mobile terminal. In addition, the memory **160** may store data regarding various patterns of vibrations and audio signals output when a touch is input to the touch screen.

The memory **160** may also include at least a flash memory, a hard disk, a multimedia card micro type, a card-type memory (e.g., a Secure Digital (SD) or DX memory), a Random Access Memory (RAM), a Static Random Access Memory (SRAM), a Read-Only Memory (ROM), an Electrically Erasable Programmable Read-Only Memory (EEPROM), a Programmable Read-Only memory (PROM), a magnetic memory, a magnetic disk, or an optical disk. Also, the mobile terminal **100** may operate in relation to a web storage device that performs the storage function of the memory via the Internet.

The interface unit **170** serves as an interface with external devices connected with the mobile terminal **100**. For example, the external devices can transmit data to an external device, receive and transmit power to each element of the mobile terminal, or transmit internal data from the mobile terminal to an external device. For example, the interface unit may include at least wired or wireless headset ports, external power supply ports, wired or wireless data ports, memory card ports, ports for connecting a device having an identification module, audio input/output (I/O) ports, video I/O ports, earphone ports, or other similar ports.

The identification module (not shown) can be a chip that stores various types of information for authenticating a particular mobile terminal **100**. The identification module can include at least a User Identity Module (UIM), a Subscriber Identity Module (SIM), a Universal Subscriber Identity Module (USIM), or other similar module. A device having the identification module (also referred to as an 'identifying device') may take the form of a smart card. Accordingly, the identifying device can be connected with the mobile terminal via a port.

When the mobile terminal **100** is connected with an external cradle (not shown), the interface unit **170** can allow power from the cradle to be supplied to the mobile terminal **100** or allow command signals input to the cradle by the user to transfer to the mobile terminal. Command signals or power input from the cradle can operate as signals for recognizing that the mobile terminal is properly mounted on the cradle.

The controller **180** controls the general operations of the mobile terminal. The controller can perform controlling and processing associated with voice calls, data communications, video calls, and the similar functions. In the example in FIG. **1**, the controller also includes a multimedia module **181** for reproducing multimedia data. The multimedia module can be configured in association with the controller or can be configured to be separated from the controller. The controller **180** can perform a pattern recognition processing to recognize a handwriting or a picture drawing input on the touch screen.

The power supply unit **190** receives external power or internal power and supplies the power required for operating the parts of the controller **180**. Various embodiments described herein may be implemented in a computer-readable, or similar, medium using, for example, software, hardware, or any combination thereof.

In hardware implementation, the embodiments described herein may be implemented by using at least Application Specific Integrated Circuits (ASICs), Digital Signal Processors (DSPs), Digital Signal Processing Devices (DSPDs), Programmable Logic Devices (PLDs), Field Programmable Gate Arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, or other electronic units designed to perform the functions described herein. In some embodiments, the claimed invention can be implemented by only the controller **180**.

In software implementation, the procedures or functions described herein may be implemented by separate software modules. Each software module may perform one or more function or operation described herein. Software codes can be implemented by a software application written in any suitable programming language. The software codes may be stored in the memory **160** and executed by the controller **180**.

FIG. **2A** is a front perspective view of a mobile terminal **100** or a handheld terminal according to an embodiment of the claimed invention.

The mobile terminal **100** can have a bar-type terminal body. However, the claimed invention is not limited to a bar-type terminal and can include a slide-type terminal body, a folder-type terminal body, a swing-type terminal body or a swivel-type terminal body having at least two bodies that are movably combined.

The terminal body includes a case (e.g., a casing, a housing, a cover or other similar exterior layer) forming the exterior of the mobile terminal **100**. In the present embodiment, the case can be divided into a front case **101** and a rear case **102**. Various electronic components are arranged in the space formed between the front case and the rear case. At least one middle case can be additionally arranged between the front case and the rear case.

The cases can be formed of plastics made by injection molding or made of metal materials like stainless steel (STS) or titanium (Ti).

The display unit **151**, the audio output module **152**, the camera **121**, user input units **131** and **132**, the microphone **122** and the interface **170** can be arranged in the terminal body **100**. In one embodiment of the terminal body, these components are located in the front case **101**.

The display unit **151** occupies most part of the main face of the front case **101**. The audio output **152** and the camera **121** are arranged in a region that is in proximity to a first of two ends of the display unit. The user input unit **131** and the microphone **122** are located in a region in proximity to the second end of the two ends of the display unit. The user input unit **132** and the interface **170** are arranged on the sides of the front case **101** and the rear case **102**.

The user input unit **131**,**132** can receive commands for controlling the operation of the handheld terminal **100**. The user input unit can include a plurality of operating units **131** and **132**. The operating units can be referred to as manipulating portions. A user can provide inputs to the operating units using a tactile manner or tactile feeling. First and second operating units may also receive other inputs. For example, the first operating unit can receive commands such as start, end and scroll. The second operating unit can receive commands that control the volume of sound output from the audio output module **152**. Alternatively, the second operating unit can control the conversion of the display unit **151** to a touch recognition mode.

FIG. **2**B is a rear perspective view of the mobile terminal **100** shown in FIG. **2**A.

Referring to FIG. **2**A, a camera **121'** can be additionally attached to the rear case **102** located at the rear side of the terminal body. The camera can have a photographing direction opposite to that of the camera and can have a number of pixels different from those of the camera.

It may sometimes be desirable for the camera **121** to have a low number of pixels such that it can capture an image and quickly transmit the image to a receiving part. It may sometimes be desirable to for the camera to have a high number of pixels such that it can capture important details of an image. The cameras can be attached to the terminal body such that they can be rotated or popped upward.

A flash **123** and a mirror **124** may be arranged in proximity to the camera **121'**. The flash can illuminate an object when the camera captures a picture of the object. The mirror can be used for the user to look at his/her own face in the mirror when the user wants to capture a picture of himself/herself using the camera.

An audio output module **152'** can be additionally provided on the rear side of the terminal body. The audio output module **152'** can achieve a stereo function with the audio output module **152**, as shown in FIG. **2**A. Alternatively, the audio output module can be used for a speaker phone mode when the mobile terminal **100** is used for a telephone call.

A broadcasting signal receiving antenna can be attached to the side of the terminal body. The broadcasting signal receiving antenna can be attached to the terminal body in addition to an antenna for telephone calls. The broadcasting signal receiving antenna can construct a part of the broadcasting receiving module **111**, as shown in FIG. **1**, and can be set in the terminal body such that the broadcasting signal receiving antenna can be pulled out of the terminal body.

The power supply unit **190** for providing power to the mobile terminal **100** is set in the terminal body. The power supply unit can be included in the terminal body or attached to and detached from the terminal body.

A touch pad **135** configured for sensing touch can be additionally attached to the rear case **102**. The touch pad can be a light transmission variation of the display unit **151**. If the display unit outputs visual information through both of its sides, the visual information can be recognized through the touch pad **135**. The information output through both sides of the display unit **151** can be controlled by the touch pad. Alternatively, a display can be additionally attached to the touch pad such that a touch screen can be arranged at the rear case **102**.

The touch pad **135** operates in connection with the display unit **151** of the front case **101**. The touch pad **135** may be located behind and parallel to the display unit **151**. The touch pad **135** may be identical to or smaller in size relative to the display unit **151**.

FIG. **3** illustrates a block diagram of a method of controlling the mobile terminal illustrated in FIG. **1**.

Referring to FIG. **3**, the mobile terminal **100** generates an HDR image using an image captured via a dual camera. The mobile terminal includes a first camera **121**_*a*, a second camera **121**_*b*, a first image processor **182**_*a*, and a second image processor **182**_*b*. Hereinafter, the operations related to the block configuration shown in FIG. **3** will be described.

The first camera **121**_*a* and the second camera **121**_*b* include a camera sensor (not shown) for capturing an image of a photographer or a subject. The camera sensor can convert the photographed light signal to an electrical signal. A signal processor (not shown) can convert an analog image signal to digital data.

The first and second image processors **182**_*a* and **182**_*b* can process images photographed by the first and second cameras **121**_*a* and **121**_*b*. The first and second image processors, however, perform a function of displaying a preview image of an image signal of the photographed subject. Further, the first and second image processors can process an image signal output from the first and second cameras per frame unit. The first and second image processors can then output the frame image data in such a way as to correspond to a characteristic and a size of the display unit **151**.

The first and second image processors **182**_*a* and **182**_*b* can compress the frame image data. Further, the first and second image processors can perform synthesizing or editing of the frame image data using a method set by the control of the controller **180**. Also, the first and second image processors can restore the compressed frame image data to the original frame image data. Frame image data may be output as on-screen display data according to the screen size displayed on the display unit by the controller.

The display unit **151** can display a preview state of an image output from the first and second image processors **182**_*a* and **182**_*b* or display a synthesized or edited image signal of a photographed image.

In order to perform HDRI processing, the mobile terminal **100** collects a first image via the first camera **121**_*a* and collects a second image via the second camera **121**_*b*. The first camera **121**_*a* and the second camera **121**_*b* may be physically separated by a predetermined gap. For example, the predetermined gap between the first camera **121**_*a* and the second camera **121**_*b* may be 6 cm. An object photographed through each camera may appear differently because the cameras are not in the exact same location when capturing their respective images. In other words, each camera captures the image from a different view point.

FIG. **4** illustrates an example of a ghost appearing on images captured using a dual camera when the captured images are synthesized together.

Referring to FIGS. **3** and **4**, when the first camera **121**_*a* is a left camera and the second camera **121**_*b* is a right camera, a first image LI acquired through the first camera **121**_*a* and a second image RI acquired through the second camera **121**_*b* are overlapped and merged as a single image.

The first and second images photographed through the first and second cameras **121**_*a* and **121**_*b*, respectively, include both a near object OB**1** and a far object OB**2**. The far object OB**2** occupies the same position within the first image LI and the second image RI, but the near object OB**1** occupies a different position in the first image LI and the second image RI. For example, the near object OB**1** may appear to be more towards the right side of a left image LI as captured by the left camera **121**_*a*; at the same time, the same near object OB**1** may be appear to be more toward the left side of a right image RI as captured by the right camera **121**_*b*.

The controller **180** generates a HDR image CI using the left image LI and the right image RI. When the left image LI and the right image RI are overlapped based on the far object OB**2**, or whenever any image is shifted to another image, the left image LI and the right image RI are matched one-to-one in the far object OB**2**; however, in the near object OB**1**, the left image LI and the right image RI are not matched one-to-one.

A disparity generated when synthesizing two images can be removed by a first image acquired being set as a reference image and a specific near object of a second image being shifted to the specific near object in the first image.

A hole generated by a shift of the specific near object can be processed and, by processing the hole, an HDR image can be generated using an image captured through the dual camera. Operations associated with generating an HDR image using an image captured through the dual camera will be described in greater detail below with reference to applicable drawings.

FIG. **5** illustrates a flowchart representing a method of controlling a mobile terminal according to an alternative embodiment of the claimed invention.

Referring to FIGS. **5** and **6**, the mobile terminal **100** acquires a first image through the first camera **121**_*a* (S**110**_*a*) and acquires a second image through the second camera **121**_*b* (S**110**_*b*).

The first camera **121**_*a* and the second camera **121**_*b* may be separated from each other by a predetermined gap. The predetermined gap may be about 6 cm.

The controller **180** of the mobile terminal **100** may set a different exposure time for the first camera **121**_*a* and the second camera **121**_*b*. For example, the controller **180** may set the first camera **121**_*a* to over-expose an image and the second camera **121**_*b* to under-expose an image.

An over-exposed first image captures more light relative to a non-over-exposed second image. An over-exposed first image generally can acquire more information about a short range object. An under-exposed second image captures less light relative to a non-under-exposed image, and the under-exposed second image can acquire more information about a shadow of an object.

As the first image and the second image are acquired, in order to process an HDR image, the controller **180** determines whether to enter an HDR mode or a general photographing mode (S**120**).

Referring to FIG. **6**, the controller **180** sets the first image acquired through the first camera **121**_*a* as a reference image and analyzes a preview image of the first image (S**121**) to determine whether HDR image processing is requested (S**122**). For example, when at least some area in the reference image includes an area saturated with a bright color, the controller determines that the reference image is an image where HDR image processing is requested. If the first image is an image in which HDR image processing is requested, the controller sets a camera photographing mode to an HDR mode (S**124**). If the first image is not an image where HDR image processing is requested, the controller sets a camera photographing mode to a general mode (S**123**).

The controller **180** may set different exposure times for the two cameras in the HDR mode. As described above, in order to photograph a subject and shadow of a background, one camera can set an exposure time to "−" and the other camera can set an exposure time to "+".

Referring again to FIG. **5**, at step S**120**, if a camera photographing mode is in an HDR mode, the controller **180** generates a preview image of the acquired first image and the acquired second image and detects an object in which a ghost may appear (S**130**).

The controller **180** overlaps the preview images of the first image and the second image and detects an object having a disparity. When the two images are overlapped, there may exist a disparity between a far object (or a background) of the first image and a far object (or a background) of the second image. If a relative position of a near object of the first image and a near object of the second image are not matched one-to-one, the controller can determine that a disparity exists in the objects. As a distance between the mobile terminal **100** and the subject decreases, the disparity can increase.

The controller **180** determines whether an object comprising a ghost is detected by analyzing an image captured by the first camera and an image captured by the second camera. Thereafter, the controller **180** controls the display unit to display an indicator in the object in which the ghost may appear (S**140**).

In order to notify that an object requests HDR processing, an indicator is directly displayed on the detected object displayed on the preview image or, alternatively, a warning message window is generated and displayed on the display unit **151**. A user can use such notifications to determine an object in which an HDR processing is necessary.

FIG. **7** illustrates a user interface providing notification about the possibility of a ghost appearing on the image.

FIG. **8** illustrates a user interface providing notification that adjusting a distance between the mobile terminal and a subject can avoid a ghost from appearing on the image.

Referring to FIG. **7**, indicators **11** and **12** for identifying objects OB**1** and OB**2** are displayed by the display unit **151**. Identifying objects OB**1** and OB**2** may require hole filling processing. A ghost may appear in a first preview image acquired by the first camera **121**_*a* and a second preview image acquired by the second camera **121**_*b*; the ghosts may be designated as objects OB**1** and OB**2**.

The controller **180** may provide a warning message **13** notifying that a ghost may appear. The controller may also provide indications directly in the objects OB**1** and OB**2** when displayed in the display unit **151**.

By providing an indicator that an object may be displayed with a ghost, a user can become aware that an object may require hole filling processing.

By providing an indication related to an object in which a ghost may appear, a user can select whether to perform image processing to remove the ghost or to proceed to capture an image despite the appearance of a ghost.

When a distance decreases between the mobile terminal **100** and a subject, the likelihood increases that a ghost will appear in an image acquired through a dual camera.

Referring to FIG. **8**, when a distance increases between the mobile terminal **100** and a subject corresponding to the

detected object, a user interface **21** is provided to notify the user to increase the distance between the camera **121** and the object.

In some embodiments, the controller **180** controls the display unit **151** to display an appropriate distance at which a ghost may no longer appear in a captured image.

FIG. **9** illustrates that HDR processing can be adjusted according to a distance between the mobile terminal **100** and the subject.

FIG. **10** illustrates that a ghost may appear according to a distance between the mobile terminal **100** and the subject.

Referring to FIG. **9**, reference numerals d**1** and d**2** represent distances between a camera **121** of the mobile terminal **100** and the subject being photographed.

At a side surface of the mobile terminal **100**, when photography is performed using two cameras, a subject at a distance d**1** has a relatively high probability of appearing as a ghost, and a subject at a distance d**2** has a relatively low probability of appearing as a ghost.

Therefore, as a distance between the mobile terminal **100** and the subject changes, the likelihood of a ghost appearing also changes. Accordingly, the likelihood of an indicator indicating that a ghost may appear may also change.

For example, when a distance between the mobile terminal **100** and the subject is d**1**, a ghost generates in both object OB**1** and the object OB**2**. Accordingly, the controller **180** can control the display unit to display indicators in both object OB**1** and object OB**2**.

However, when a distance between the mobile terminal **100** and the subject increases to d**2**, a ghost may not appear in the object OB**1**. Accordingly, the controller **180** can control the display unit to no longer display the indicator of object OB**1**. However, because a ghost still generates in the object OB**2**, the controller **180** controls the display unit to maintain the display of the indicator of the object OB**2**.

FIG. **11** illustrates an example of a user interface notifying that a HDR processing can be performed by a user selection when an object in which a HDR processing is requested exists.

Referring to FIG. **11**, when the mobile terminal **100** enters an HDR mode, even if an object may contain a ghost, a process of processing the ghost (i.e., hole filling processing) may not be performed through a preview image. That is, the mobile terminal **100** may generate the ghost, but the ghost may not be recognized by a user's visual sense.

In a process of acquiring an HDR image, the controller **180** provides a user interface **22** on display unit **151** for indicating that a ghost appears and inquiring whether to capture the photograph (**22**).

In the foregoing exemplary embodiment of the mobile terminal environment having a dual camera, at least the following is provided: operations of determining whether HDR processing is requested based on a preview image acquired through any one camera of the dual camera; detecting an object in which a ghost may appear based on a first and second preview images; and notifying a user about the possibility of a ghost appearing to allow for the option of HDR processing.

Described herein is a process of generating an HDR image from a detected object in which a ghost may appear.

FIGS. **12** to **14** are flowcharts illustrating a method of performing the hole filling processing. FIGS. **15** to **17** are illustrations corresponding to the method of performing hole filling processing as depicted in FIGS. **12** to **14**.

Referring to FIG. **12**, the controller **180** of the mobile terminal **100** shifts an object in which a ghost may appear. An object in which a ghost may generate in a first image is assumed to be a first object, and an object in which a ghost may appear in a second image is assumed to be a second object.

Upon inputs A and B, a shift detected object is determined (S**210**). The hold is filled (S**220**), and the HDR image is stored (S**230**).

The first object and the second object may consist of images in which the same subject is viewed via the first image and the second image, respectively.

When an image acquired through the first camera is assumed to be a reference image (e.g., see FIG. **16**) and the first image and the second image are overlapped, the first object (OB**1** of FIG. **16**) and the second object (OB**2** of FIG. **16**) are substantially the same subject. It can sometimes be necessary to correct an image to correspond to a reference image. The controller **180** can set an exposure time of the first camera to be longer than that of the second camera. The controller **180** can also set a brightness of the first image to be brighter than that of the second image.

When synthesizing and editing the first image and the second image, histogram distribution of each image can be used.

FIG. **13** is a flowchart illustrating a method of processing an object in which a ghost may appear. Referring to FIG. **13**, the controller **180** can analyze histogram distributions of the first and second images.

The controller **180** can analyze histogram distribution of a first area corresponding to an object and in which a ghost of the second image may appear in the first image (S**310**). The controller can also analyze histogram distribution of a second area existing between an area corresponding to an object in which a ghost of the second image may appear and a proximate area of the object in the second image (S**320**). A hole may be created due to an object shift.

Referring to FIG. **14**, the controller **180** shifts an object in which a ghost of the second image may appear to a corresponding area of the first image (S**211**). The controller can fill a hole generated by the shift (S**221**). In more detail, the controller **180** fills the hole based on histogram distribution of the first and second areas. A process of filling the hole is described in more detail with reference to FIG. **15**.

Referring to FIG. **15**, the controller **180** analyzes histogram distribution of the first area **51** in a first image (i.e., a reference image) **11** corresponding to an object in which a ghost of a second image **12** may appear (S**310**).

The controller **180** can also analyze the histogram distribution of a second area **52** existing between an area (area occupied by OB**2**) corresponding to an object OB**2** in which a ghost of the second image **12** may appear and a proximate area of the object in the second image **12** (S**320**).

A reason for analyzing the histogram distribution of the second area **52** is to allow at least different exposure times or different brightness for the first image **11** and the second image **12**. Another reason for analyzing the histogram distribution of the second area **52** is determine its similarity relative to the histogram distribution of a hole generated by the shift when the first image **11** and the second image **12** are overlapped and the second object OB**2** is shifted to the first object OB**1**.

FIG. **16** illustrates an example in which the first image and the second image are overlapped. Referring to FIG. **16**, the controller **180** can overlap the first object OB**1** and the second object OB**2** based on a far object **60** or a background. Accordingly, the first object OB**1** and the second object OB**2** may exist in one image I**1** and I**2** (I**1**+I**2**). Thereafter, the second object OB**2** can be shifted to the first object OB**1**.

A hole can be shifted, as shown in FIG. **17**. The controller **180** fills a hole generated with reference to the histogram distribution of the first image and the histogram distribution of the second image, as described with reference to FIG. **13**.

The above-described method of controlling a mobile terminal according to the present invention may be written and provided in a computer readable recording medium with a program executable in a computer.

The method of controlling the mobile terminal according to the present invention may be executed through software. When executed by software, constituent means of the present invention are code segments that perform required tasks. Programs or code segments may be stored in a processor readable medium or may be transmitted by a computer data signal combined with a carrier through a transmission medium or a communication network.

The computer readable recording medium may be any data storage device configured for storing data that can be read by a computer system. The computer readable recording medium may include, for example, a read-only memory (ROM), a random-access memory (RAM), a CD-ROM, a DVD±ROM, a DVD-RAM, a magnetic tape, a floppy disk, a hard disk, or an optical data storage device. The computer readable recording medium may also be distributed in a computer system connected to a network and, thus, a computer readable code may be stored and executed in a distributed manner.

The foregoing embodiments and features are merely exemplary in nature and are not to be construed as limiting the claimed invention. The disclosed embodiments and features may be readily applied to other types of apparatuses. The description of the foregoing embodiments is intended to be illustrative and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the relevant art.

What is claimed is:

1. A mobile terminal comprising:
- a display unit;
- a first camera configured to acquire a first image from a first view point;
- a second camera configured to acquire a second image from a second view point that is different from the first view point; and
- a controller configured to:
  - detect at least one object comprising a ghost in preview images of the first or second images,
  - control the display unit to display an indicator corresponding to the detected at least one object, and
  - determine whether a user requests high dynamic range (HDR) image processing on the detected at least one object.

2. The mobile terminal of claim **1**, wherein the controller is further configured to:
- switch from a photographing mode to an HDR operating mode when the preview image of the first image comprises at least one saturation area.

3. The mobile terminal of claim **1**, wherein the controller is further configured to:
- detect the at least one object when a disparity exists between overlapped preview images of the first and second images.

4. The mobile terminal of claim **1**, wherein the indicator comprises at least a highlight or a text message.

5. The mobile terminal of claim **1**, wherein the controller is further configured to:
- detect selection of the detected at least one object; and
- control the display unit to display information about the detected at least one object according to a distance between the mobile terminal and the detected at least one object in response to the selection of the detected at least one object.

6. The mobile terminal of claim **3**, wherein the controller is further configured to:
- control the display unit to display a user selection menu that inquires whether to capture a video or an image in response to the selection of the detected at least one object.

7. The mobile terminal of claim **3**, wherein the controller is further configured to:
- re-detect the at least one object comprising the ghost in the preview images of the first or second images; and
- control the display unit to display an indicator corresponding to the re-detected at least one object when a distance between the mobile terminal and the re-detected at least one object is changed.

8. The mobile terminal of claim **1**, wherein:
- the first camera is set to over-expose the first image, and
- the second camera is set to under-expose the second image.

9. The mobile terminal of claim **8**, wherein the controller is further configured to:
- overlap background images of the first and second images; and
- apply histogram distribution analysis results from the first and second images to a hole when the detected at least one object in the second image is shifted to a corresponding area in the first image.

10. The mobile terminal of claim **9**, wherein the controller is further configured to:
- analyze a histogram distribution of a first area, the first area corresponding to the at least one object in the first image;
- analyze a histogram distribution of a second area, the second area corresponding to an area proximate to the first area; and
- change the histogram distribution of the first area with reference to the histogram distribution of the second area.

11. A method of controlling a mobile terminal, the method comprising:
- acquiring a first image by a first camera from a first view point;
- acquiring a second image by a second camera from a second view point that is different from the first view point;
- entering a high dynamic range (HDR) operating mode;
- detecting at least one object comprising a ghost in preview images of the first or second images; and
- displaying an indicator corresponding to the detected at least one object.

12. The method of claim **11**, further comprising:
- analyzing a histogram distribution of a first area, the first area corresponding to the at least one object in the first image;
- analyzing a histogram distribution of a second area, the second area corresponding to an area proximate to the first area; and
- overlapping the first and the second images;
- shifting the detected at least one object from the second image to a corresponding area of the first image; and
- changing the histogram distribution of the first area with reference to the histogram distribution of the second area.

13. The method of claim 11, further comprising:

switching from a photographing mode to an HDR operating mode when a preview image of the first image comprises at least one saturation area.

14. The method of claim 11, further comprising:

detecting the at least one object when a disparity exists between overlapped preview images of the first and second images.

15. The method of claim 11, wherein the indicator comprises at least a highlight or a text message.

16. The method of claim 11, further comprising:

detecting selection of the detected at least one object; and

controlling a display unit to display information about the detected at least one object according to a distance between the mobile terminal and the detected at least one object in response to the selection of the detected at least one object.

17. The method of claim 14, further comprising:

controlling a display unit to display a user selection menu that inquires whether to capture a video or an image in response to the selection of the detected at least one object.

18. The method of claim 14, further comprising:

re-detecting the at least one object comprising the ghost in the preview images of the first or second images; and

controlling the display unit to display an indicator corresponding to the re-detected at least one object when a distance between the mobile terminal and the re-detected at least one object is changed.

19. The method of claim 11, wherein:

the first camera is set to over-expose the first image, and

the second camera is set to under-expose the second image.

20. The method of claim 11, further comprising:

overlapping background images of the first and second images; and

applying histogram distribution analysis results from the first and second images to a hole when the detected at least one object in the second image is shifted to a corresponding area in the first image.

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